

**Meteorology 3510**  
**Exercise #9**  
**Due Tuesday, April 1, 2008**

This exercise deals with applications of the hydrostatic equation.

1. What is the thickness of the 1000–700 mb layer when the average temperature of the layer is  $10^{\circ}\text{C}$ ?
2. What is the thickness of the 1000–500 mb layer when the temperature at 1000 mb is  $0^{\circ}\text{C}$  and the temperature at 500 mb is  $-30^{\circ}\text{C}$ ? Assume that the temperature lapse rate is constant.
3. What is the thickness of the lowest 200 hPa of the atmosphere if the surface pressure is 1000 hPa, the surface temperature is  $10^{\circ}\text{C}$ , and the lapse rate is dry adiabatic?
4. What is the pressure at a height of 2 km for a dry isothermal atmosphere with a surface pressure of 1000 mb and a temperature of  $-30^{\circ}\text{C}$ ?
5. What is the pressure of a dry atmosphere at a height of 4 km if the pressure at 0 km is 1000 mb, the temperature is  $30^{\circ}\text{C}$ , and the lapse rate is  $6.5\text{ K km}^{-1}$ ?
6. What are the pressure and temperature at the top of Lone Peak (elevation 11,253 ft) if at Salt Lake City airport (elevation 1288 m) the pressure is 868 hPa and the temperature is  $11.2^{\circ}\text{C}$ ? Assume that the lapse rate is equal to that of the U. S. Standard Atmosphere.
7. An altimeter estimates the elevation from the pressure and an assumed atmospheric temperature profile. This problem is an example of such a calculation. Estimate the elevation if the pressure is 400 hPa. Assume that the temperature profile is the same as that of the U. S. Standard Atmosphere.
8. Forecasting the occurrence of snow versus rain depends on the near surface temperature, but surface temperature is not easily determined from the standard numerical weather prediction model output, especially in regions of complex topography. However, one can calculate the critical thickness for a standard pressure layer that is associated with the occurrence of a surface temperature of  $0^{\circ}\text{C}$  or less. Calculate the critical thicknesses of the 850-700 hPa and 850-500 hPa layers associated with a temperature of  $0^{\circ}\text{C}$  at 850 hPa. Assume that the lapse rate is equal to that of the U. S. Standard Atmosphere.